Summer 1999 **Technical Update #3**

Eastern Gamagrass for Forage, Soil Improvement, and Buffer Strips

(This publication is a result of scientists at the ARS Beltsville Agricultural Research Center, the University of Maryland, NRCS and the Maryland Extension Service working on a grant project funded through the Fund for Rural America program.)

Project Activities- Awards Presented

The USDA Agricultural Research Service, Natural Resources Institute (NRI) honored Dr. Errol G. Rhoden, Professor, College of Agricultural, Environmental and Natural Sciences, Tuskegee University, and USDA Natural Resources Conservation Service (NRCS) employees John Davis and Janet Graham at a recent awards ceremony. Each received a plaque and certificate of appreciation in recognition of their outstanding contribution to cooperative research on eastern gamagrass in fiscal year 1999. John and Janet are both on the Mid-Atlantic Interdisciplinary Resource Team within NRCS.

Dr. Errol Rhoden is collaborating with Dr. Donald T. Krizek of the Climate Stress Laboratory and Dr. Jerry C. Ritchie of the Hydrology Laboratory in studying root growth of eastern gamagrass in the greenhouse and in acid-compact soils in the field. Dr. Rhoden worked on the project for 6 weeks last summer at Beltsville and has returned to Beltsville several times to do follow up experiments

John collaborated with ARS researchers Donald Krizek and Charles Foy, Climate Stress Lab, Jerry Ritchie, Hydrology Lab, and Ali Sadeghl, Environmental Chemistry Lab in characterizing soils used in a field study on root penetration of eastern gamagrass in acid-compact soils. John also took the lead in obtaining detailed computer graphics illustrating the extent of restricted soils in the Mid-Atlantic Region. These activities resulted in several research posters and scientific publications.

Janet also collaborated with the scientists to produce a video, "Eastern Gamagrass: From the Past to the Future", which was widely distributed and well received across the nation. She also published two issues of the "Technical Update" to help educate field staff on eastern gamagrass.

Beltsville Study Site for Eastern Gamagrass Research, *by John Davis*

The Beltsville study site is located on a nearly level to strongly sloping landscape derived from fluvio-marine sediments. Typically, the soil surface is eroded, contains less than fifteen percent gravel and ranges in texture between clay loam and loamy sand. The soils are moderately to very strongly acid throughout and are estimated to have moderate to high available water holding capacity. The site is dominated by moderately well or better drainage classes and is not prone to flooding.

Six pedons were excavated and described on-site using standard USDA National Cooperative Soil Survey methods and nomenclature. Available Water was predicted based on field assessment of soil textures. Soil pH values were evaluated from horizon samples diluted 1:1 in distilled water and tested with a field-kit meter. The horizons of each pedon were assessed for abundance and size of plant roots present. All six profiles exhibited reduced root penetration at less than 30cm depths. Recorded values of 1-5roots, 1-5mm in diameter in dm^2 assessment area were typical. All profiles were considered restrictive at depths less than 60cm where fewer than 1 root, less than 2mm in diameter in cm^2 assessment areas were recorded. Individual pedons became restricted to root penetration at depths of 25, 36, 46, 51, 53 and 57 cm.

Most pedons displayed a tendency toward development of denser, potentially restrictive, platy structure in a discontinuous pattern at variable depth in the subsoil. Abrupt textural changes at the contact between subsoil horizons appear to perch water for brief periods during wet periods. Root extension into deeper horizons did appear reduced at many of these contacts probably due to reduced porosity or perhaps saturated conditions. In all pedons the substratum was stratified and comprised of layers that are variable in thickness, texture, and in the amount and size of gravel contained.

Research Reports

- Aluminum Toxicity and High Bulk Density: Role in Limiting Shoot and Root Growth of Selected Aluminum Indicator Plants and Eastern Gamagrass in an Acid Soil, Charles Foy, Ali Sadeghi, Jerry Ritchie, Donald Krizek, John Davis and W. Doral Kemper.
  (Journal of Plant Nutrition 22 (10): 1551-1566. 1999)

Abstract:
Shallow rooting and susceptibility to drought are believed to be caused, at least in part, by strongly acidic (pH <5.5, 1:1 soil-water), Al-toxic subsoils. However, this hypothesis has not been clearly confirmed under field conditions. Difficulty in diagnosing the problem may be due to the fact that Al toxicity is often manifested by symptoms other than those of drought. Furthermore, the detrimental effects of Al may be confounded with those of soil physical factors, such as high bulk density, flooding and associated oxygen deficiency. The Al toxicity hypothesis was tested on a map unit of Matawan-Hammonton loam (0-2% slope) on unlimed and limed field plots (pH range 5.1 to 5.8) at Beltsville, MD during 1994 to 1998. Aluminum-tolerant and sensitive pairs of barley [*Hordeum vulgare* L.], wheat [*Triticum aestivum* (L.)], snap bean [*Phaseolus vulgaris* L.], and soybean [*Glycine max* (L.) Merr.] cultivars were used as indicator plants. Eastern gamagrass [*Tripsacum dactyloides* (L.) L.] cultivar 'Pete', reported to tolerate both chemical and physical stress factors in soils, was grown for comparison.

Shoots of Al-sensitive 'Romano' snapbeans showed a significant response to liming of the 0-15 cm surface layer, but those of Al-tolerant 'Dade' did not, indicating that Al toxicity was a growth limiting factor in this acid soil at pH 5.1. Lime response of the Al-tolerant and sensitive cultivars of barley, wheat, and soybean were in the same direction but not significant at the 5% level. Aluminum- tolerant and sensitive cultivars did not differ in abilities to root in the 15-30 cm soil depth. Only 9 to 25% of total roots were in this layer, and 75 to 91% were in the 0-15 cm zone. No roots were found in the 30-45 cm zone which had a pH of 4.9. Soil bulk density values of 1.44 and 1.5 cm^3, in the 15-30 and 30-45 cm zones, respectively, indicated that mechanical impedance was a primary root barrier.

Results indicated that restricted shoot growth and shallow rooting of the Al-indicator plants studied in this acid soil were due to a combination of Al toxicity and high soil bulk density. Confounding of the two factors may have masked the expected response of indicator plants to Al. These two growth restricting factors likely occur in many, if not most acid, problem subsoils. Studies are needed to separate these factors and to develop plant genotypes that have tolerance to multiple abiotic stresses. Unlike the Al indicator cultivars, eastern gamagrass showed high

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tolerance to acid, compact soils in the field and did not respond to lime applications (pH 5.1-5.8).

Research Reports Continued:

Several reports on our joint research on gamagrass will be presented at the coming meeting of the Second Grasslands Symposium to be held at the Convention Center in Baltimore, MD in November 17-19, 1999. On Nov. 16, just prior to the symposium, there will be a meeting of the ARS/NRCS Grass Hedges and Vegetative Buffers Group at Beltsville, MD to enable attendees to visit greenhouse and field research being conducted by Jerry Ritchie, Donald Krizek, Charles Foy, Ali Sadeghi, James Reeves, and Doral Kemper on eastern gamagrass and miscanthus.

Field Days: Don Krizek, Jerry Ritchie, and Ali Sadeghi had a display on eastern gamagrass in the tent at the Public Field Day at the Beltsville Agricultural Research Center (BARC) on June 5. The public is invited to attend the coming Sustainable Agriculture and IPM Field Day to be held at BARC on August 11, 1999. Among the stops to be visited will be the field plots of eastern gamagrass growing on an acid, compact soil on the North Farm.

Interesting Tidbits (Realities of Life with Plants)

The following items were brought up among NRCS Plant Material Specialists at a meeting held at the National Plant Material Center in August 1998.

Eastern gamagrass has many potentials that have yet to be tapped, such as its use as a biofuel, for soil remediation, as a forage, in wetlands, for nutrient uptake, and tidal shoreline stabilization. Many scientists are looking for a miracle plant; eastern gamagrass comes the closest to what we are seeking.

However, the plant does have its limitations. When the plant reaches a large clump size the middle of it may die off with the rest of the plant growing from around the edges in future seasons. This characteristic may limit it's effectiveness if used in a pure stand as a buffer plant because the overflow may go right over the dead center of the plants. This characteristic may also inhibit its use as year-round wildlife habitat if planted as a pure stand. However, it was brought up that having eastern gamagrass in a mix for wildlife purposes increases the value of the mix.

It was also mentioned that north eastern states from Pennsylvania up to Maine may experience frost heaving of the seedlings as the soil freezes and thaws making stand establishment difficult. In 1998 the PMC in New York dug up those that survived frost action for further study.

So while eastern gamagrass has proven itself in the past as a native species with many benefits, there are still many issues we need to work out in order to fully exploit its potential.

Research in progress:

Several cooperative studies on gamagrass are being conducted this summer at Beltsville and at other locations by ARS, NRCS, University of Maryland, and Maryland Cooperative Extension (MCE) researchers. Over 25 acres of gamagrass have been planted in several Maryland counties by MCE researchers to evaluate the performance of eastern gamagrass in comparison with other warm season grasses. ARS researchers have planted 10 acres of gamagrass at the Compost Facility at BARC-East under the direction of Larry Sikora and Jerry Ritchie to provide a buffer against runoff of nutrients. Two research studies are in progress at BARC-West on the South Farm and at Buckeystown, MD to evaluate the effectiveness of several pre-emergent pesticides, under the direction of University of Maryland scientist Les Vough and ARS scientist Ben Coffman. Greenhouse studies are being conducted at BARC-West under the direction of Donald Krizek. Cooperative studies were conducted with NRCS scientist John Davis to characterize the soils at the North Farm. Cooperative studies have also been conducted with Errol Rhoden at Tuskegee University.

Keep an Eye Out

Watch for future technical updates on this project!

Project Participants

Initial contacts concerning the project may be directed to the following persons, however the list of participants is much longer:

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